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MARINE BIOLOGICAL LABORATORY DEDICATION EXERCISES, JULY 3, 1925

THE new building and endowment of the Marine Biological Laboratory were formally dedicated to the service of science on Friday, July 3, at 2 P. M. in the presence of a representative gathering of biologists and guests. More than one hundred institutions of higher learning in America appointed official delegates, and others were represented unofficially by workers in Woods Hole. Cabled or written greetings were received from marine laboratories in England, Norway, Sweden, Denmark, France and Italy. The occasion is of interest to the scientific public, and more especially to biologists, because the laboratory by its organization and use is the possession of the biologists of America. It is attached to no one institution or section of the country but seeks to serve all.

The Honorable Charles R. Crane, president of the board of trustees of the laboratory, was the presiding officer. In his opening remarks he alluded to the spirit of the laboratory which he characterized as its most unique possession and of priceless worth. Mr. Crane continued:

Even though not personally associated with the vital processes of the laboratory it has been the greatest possible privilege to play the part of a simple spectator in watching the growth of the wonderful spirit of cooperation in the work of biological research.

Some years ago the then business manager of the Rockefeller Institute for Medical Research invited me to spend the evening with him and try to help him understand the nature and conditions of the spirit of the Marine Biological Laboratory. "For," said he, "we all recognize that the spirit is there. It is the rarest thing that we know of, and we have many discussions as to its nature and the conditions under which it has come forth." He then asked me if I had any theory about it. I answered that the essential thing, as it seemed to me, was that it was the purest expression of the highest form of democracy—a form of Soviet directed by the highest rather than the lowest motives.

Many years ago I was associated with a Society for Psychical Research. I followed its processes with a great deal of interest, and although its work was not of so exact and definite a nature as the work of the laboratory here, there seemed to be certain conclusions arrived at regarding the haunts and habits of spirits. One definite conclusion was that spirits feel most at home and make larger demonstrations of their presence in old buildings and among old friends. They are very con-

servative and hard to entice abroad. When I was in business I had several experiences with this process and found great difficulty in getting the spirit of old factories transferred to new and modern ones that were much better provided with material and equipment.

We all know that this spirit which we are so much concerned about has long been domesticated in the old buildings across the street and among the older biologists. Although the street is a very narrow one, the mission of inviting the spirit of the laboratory into the new and more modern buildings and giving it a longer lease of its great power is mainly up to the younger biologists now coming along. Much power to them!

Mr. Crane then introduced in succession the director of the laboratory, Professor Frank R. Lillie, Professor Edmund B. Wilson, of Columbia University, and Professor E. G. Conklin, of Princeton University, for their addresses. The formal exercises were followed by a reception, inspection of the building and in the evening by a lecture delivered by Professor W. J. V. Osterhout of Harvard University, on "Absorption and accumulation."

The afternoon addresses follow.

Address of the Director, Frank R. Lillie

After extending greetings and welcome to the delegates, guests, workers and members of the laboratory the director interpreted the occasion to the meeting as follows:

We are gathered to-day to dedicate this beautiful building and its endowment to the advancement of science and the good of humanity and to rededicate ourselves to these causes. The scientist devotes his life to increase of learning in the belief "that there is no alleviation for the ills of mankind but in the resolute facing of the world as it is," and with firm faith that by patient seeking the truth concerning man's relations to his world may be found. Through generation after generation of effort, always hard and often ill-rewarded, there has been produced a great body of scientific fact and of hypothesis useful for criticism of creed and custom, for inspiration, for human needs. We are inheritors of this sacred legacy; it is our trust to preserve and develop it.

The science of biology has grown mightily since Darwin's time and has contributed greatly to human culture and human welfare. Its greatest possibilities for the good of mankind, however, still lie in the future, and their realization depends on the progress of discovery, which in its turn rests on the labors of scholars, on the tasks of research.

The farther science advances, the greater the requirements for fruitful investigation. The history of this laboratory illustrates the rate of this progress in the last thirty-seven years. The wooden buildings corresponded well with the needs of investigators in the early days of the laboratory. The Crane building, constructed twelve years ago, was a measure of the needs of that time, and we hope that this new structure and the reconstruction undertaken in the Crane building measure up to present needs, and that they are sufficiently flexible in their provisions to serve the uses of biological science for many years to come.

This is a *research* institution; all its personnel and facilities are provided to aid in the tasks of the investigators. There are officers to conduct the business of the institution, men to man the boats and nets and other apparatus with which the produce of the sea is collected; others to design and keep in order the elaborate apparatus and equipment and to assign their use; yet others to ensure a continuous supply of sea-water to rooms and aquaria, to keep our complicated electrical system in order and attend to other mechanical needs; a department to house and feed the workers; a department to care for buildings and grounds; a library personnel and a library that we aim to make the best possible source of reference in its field. All these persons and facilities are at the service of the investigator.

Believing that it is no less our function to produce investigators than to promote the actual work of investigation, the laboratory also offers instruction to a limited group carefully selected from the best students of biology of American universities. These are the young people whose presence enlivens our proceedings for six weeks in the summer. There are also the candidates for professional status in biology, about seventy in number, graduate students beginning investigation or in early stages of a career of investigation, coming from the principal centers of biological investigation in our universities. These fortunate students receive the benefits of the standards and ideals of research of many institutions during the weeks or months of their work at Woods Hole, an advantage to be procured in no other way.

The laboratory is a *cooperative* organization. Its ownership rests in a corporation of some 350 members, the great majority of whom are professional biologists. Its affairs are administered by a board of trustees of thirty-five members elected by the corporation, composed, with but *two most valuable exceptions,* of university professors in various fields of biology of some twenty-five institutions; detailed administration is in the hands of an executive committee of five chosen by the board from its own membership. As substantially all the members of the Marine Biological Laboratory are representatives in one capacity or another of American universities, col-

leges and research organizations, so in practice the laboratory belongs to these institutions; here they have extra-territorial privileges and abiding place; and the contributions that they make to the support of the laboratory in return for the various uses of their biological departments constitute their recognition of this relationship. In 1924 seventy-two American institutions of learning thus contributed. This relationship is usually maintained through the university departments concerned and is continued at the pleasure of such departments; but in the case of the larger institutions it is a constant and continuing one. The smaller institutions enjoy here the same advantages as larger ones, and thus the handicaps of their necessarily less adequate provisions for research at home are to some extent equalized.

The laboratory is *national* in its scope. There is no sectionalism in its organization or in its life. It was established in New England by New Englanders and is strongly supported by the institutions of this part of the country; but it is no less strongly supported by the institutions of other eastern states; and indeed in proportion to cultural and geographical conditions by more remote states of the Union. Twenty-seven of the seventy-two cooperating institutions of 1924 lie west of the Alleghenies. Twenty-eight states of the Union were represented by the workers last year, and the following countries—Brazil, Canada, China, England, Holland, Hungary, Japan, Poland, Sweden. The laboratory has indeed numerous other international connections and extends its welcome to all qualified investigators of whatever nation.

The laboratory also represents all fields of biology; it is not controlled by any one biological sect, neither by Darwinians or Lamarckians, by vitalists or mechanists, by zoologists or botanists, by morphologists or physiologists. It aims to provide suitable facilities for all kinds of biological work. It thus has no program of its own for the development of one or even several directions of biological investigation, save in the broadest sense. As it is catholic in its membership, so also is it catholic in its interests. This policy keeps it abreast of scientific interests; it ensures the use of means and equipment for the most promising problems of the time; it provides for a constant renewal of strength.

As part of this policy the laboratory avoids salaried appointments on its scientific staff, excepting those concerned in the courses of instruction, who receive small emoluments. The laboratory thus does not enter into competition with universities for personnel. Voluntary leadership in the various departments of biology within the institution has proved most devoted, sufficiently continuous for all matters of scientific policy and also flexible enough to avoid unprofitable specialization of the uses and of the means of the laboratory.

The Marine Biological Laboratory was given its name and location on the seashore, because at the time of its foundation the value of the life of the ocean as material for the study of biological problems was beginning to be fully recognized after some fifteen years of fruitful activity on the part of the Naples Zoological Station. The expectations of the advantages to be derived from the study of marine material have, I venture to say, been exceeded in the results. The life of the ocean has proved our greatest asset in the contributions to the advancement of biological science made here. But this asset places no limitations on the use of the other biological materials, and in addition we draw on whatever sources of supply that inland institutions use.

The Marine Biological Laboratory traces its origin from the establishment of the "Anderson School of Natural History" on the island of Penikese by Louis Agassiz in 1873; Agassiz died in the winter of that year, and the school was continued the following summer under the direction of his son, Alexander Agassiz, but was then abandoned. From 1880 to 1886 a seaside laboratory was maintained at Annisquam, Massachusetts, under the direction of Alpheus Hyatt, a student of Agassiz, by the Woman's Education Association of Boston in cooperation with the Boston Society of Natural History. The present organization was established and incorporated in 1888 as the result of an effort made by the group interested in the Annisquam Laboratory to secure an independent and broader foundation. A site was selected at Woods Hole and a plain wooden building, now the south wing of our large wooden laboratory, was erected here and opened for work on July 17, 1888.

The first director was Professor Charles Otis Whitman; under his inspiring leadership the laboratory grew rapidly, the entire series of wooden buildings was erected and the principles of organization and administration outlined above was developed. With grateful acknowledgment to the far-sighted citizens of Boston who founded the laboratory I think it may be said that it was to Professor Whitman more than to any other single person that the laboratory owes its form of organization, its scientific ideals and its national character. Professor Whitman was successful in securing and maintaining the cooperation of scientific men of the first rank in building up this enterprise. The development of the laboratory rests upon the high reputation and earnest devotion of many of the leading biologists of America working together for a common purpose.

In 1913 Mr. C. R. Crane, president of the board

of trustees, presented the laboratory with the beautiful building annexed to this, which was imperatively needed for the growth of the institution, and for the accommodation of the more refined methods of investigation then developing. This was in a way our first footing on a permanent basis; the wooden buildings had always been recognized as temporary accommodations.

The war intervened to slow down development, but before the close of the war it was apparent that the existing buildings and equipment were inadequate to measure up to the needs and to the responsibility for the development of biological research with which we were confronted. Efforts began immediately after to secure recognition of America's responsibility for furnishing the best possible marine observatory and to secure the funds necessary for building, equipment and endowment. In this endeavor we received invaluable aid from the National Research Council, which lent our organization its unqualified endorsement and moral support, so sadly needed by a society of impractical professors. It required five years to secure the necessary pledges and now at the end of the sixth year of effort we enter upon the enjoyment of the fulfilled expectation.

These years were, I believe, well spent in the prolonged and painstaking studies led by the assistant director, Dr. Gilman A. Drew, and the architect, Mr. Charles Coolidge, to ensure the best kind of building for the most advanced types of biological research. I doubt if so large a body of experts as those called in consultation here ever combined their advice in the construction and equipment of a laboratory building. The defects of this building, whatever they may be, are certainly not due to any lack of foresight. There may possibly have been confusion of counsel, though the spirit of combined action in a common cause reduced even this to a minimum.

The present occasion is clouded by the absence of Dr. Drew, owing to continued ill-health, towards which his unremitting labors on this building were certainly a contributing cause.

The amount raised for the purposes described was \$1,648,000. The donors were The Friendship Fund (Mr. C. R. Crane, president), Mr. John D. Rockefeller, Jr., The Rockefeller Foundation and the Carnegie Corporation. Of this amount \$900,000 has been invested in securities, and placed in the hands of a trust company as a permanent endowment fund. The balance, amounting to \$748,000, has been expended on the building and equipment or set to credit of the latter. The total resources of the laboratory now amount to considerably over \$2,000,000.

The immediate purposes of this building are explained by the progress of the biologcial sciences in the last twenty-five years. During the nineteenth century a large part of the descriptive functions of biological investigation was accomplished, whether in the identification, naming and description of the various species of animals and plants or in the comprehensive study of their gross or microscopical anatomical structure or of their stages of development or of their distribution in space and time. Accompanying these descriptive disciplines, theoretical interpretations, as in the evolution theory and the cell-theory as instances, were developed. In the latter part of the nineteenth century, also, in proportion as descriptive disciplines laid bare the problems, experimental methods of analysis of these problems arose. The *raison d'être* of this tendency is not difficult to see: in the first place the experimental method had established itself in physics and in chemistry and in certain of the medical sciences as the only method for a progressive attack on the problems of these sciences, and had justified itself by the control thus acquired over natural processes; and in the second place it was becoming apparent that all vital processes were susceptible of analysis into chemical and physical processes, to an extent at least that justified the expectation of far-reaching control.

Fundamental biological analysis requires experiment and also the facilities of chemical and physical laboratories, joined to the equipment of a biological laboratory. Such experiments were begun by Jacques Loeb, Albert Mathews and others in our old wooden buildings, but the inadequacy of such structures for thorough exploitation of the problems soon became manifest. Hence the first of our permanent buildings was erected in 1913. Since then there has been a rapidly increasing rate of development of the experimental method in biology, and it has long been apparent that in order to continue to serve the interests of biological science in America a building of the type of this new one was required.

We have often been asked, seeing that our work lies so largely in the summer months, why we could not be satisfied with additional wooden buildings. We are not convinced that the work will always continue to be so exclusively confined to summer months; there is already a pronounced tendency for it to spread into the spring and into the autumn. However, a conclusive reason is that operations of extreme delicacy, as in measurements of minutest electrical fluctuations or thousandths of a degree of temperature, are involved in certain experimental work, and that the greatest possible degree of stability of the building is required for such work, and other work also. Hence such buildings must be constructed solidly of steel and cement.

You will find in this building arrangements for

the study of X-ray and other radiations on protoplasm, arrangements for study of minutest electrical and thermal variations, arrangements in dark rooms for studying all phases of the effects of light upon protoplasm, rooms for studying the chemistry of protoplasm and its constituent parts, photographic, cold storage and constant temperature rooms, laboratories for more strictly biological work, large supply rooms and a machine shop for manufacture of apparatus. To each work-room fresh water, sea-water, electrical current, both direct and indirect, capable of regulation as to voltage, and gas are supplied. Across the street is a small but very efficient pumping plant.

In constructing this building we also took account of the rapidly growing needs of our library and have provided stack rooms for 100,000 volumes, a commodious reading room and librarians', cataloguing and work rooms. Finally, this beautiful auditorium will provide for our public lectures and meetings, which have hitherto been so poorly housed.

The laboratory is a research, teaching, cooperative, national and international institution covering all fields of biology, with roots of gradual growth firmly planted in American soil. This is claiming much, but we dare not adventure less. May all our friends aid us in the effort to live up to these declared ideals!

Extracts from Remarks by Professor Edmund B. Wilson

Professor Wilson, who referred to himself as the "oldest inhabitant," recalled memories of the U. S. Fish Commission and the "M. B. L." extending back over a period of nearly fifty years. He emphasized the astonishing contrast between the primitive conditions of the early years at Woods Hole and the splendid development that ensued. Recalling some of the earlier leaders who shaped the destinies of biological work at Woods Hole, Professor Wilson continued:

Among the memories of those earlier days there are two dominating figures, which in this company I do not need to name—Spencer F. Baird and Charles O. Whitman; Baird, the discoverer of biological Woods Hole, the man who first clearly saw the possibilities of the place for a great center of biological work, and the founder of the U. S. Fish Commission; Whitman, the creator and first director of the M. B. L. It was my good fortune to know both of them well, and I esteem it an especial privilege to pay my tribute of homage to them to-day. The two men were widely different, in some respects diametrical opposites. Baird was a typical American, and he looked the part. I have heard it said that he seemed like a fine old Yankee farmer—which I take to have been a compliment both to the farmer and to Baird. He was a man of forceful but winning personality. I seem to see him at this moment strolling along the road out there—his burly figure; his rather slow, ponderous and rolling gait; his bright and expressive eye. I recall his friendly manner, and seem to hear his characteristic voice—rather high pitched, cultivated and pleasant to the ear. He was an eminent naturalist of the old school, trained as a field collector and systematist, distinguished as an ornithologist, mammalogist and ichthyologist. I am afraid he had not overmuch sympathy with what was then the new movement in biology, and I remember hearing him give emphatic expression to this attitude—very likely as a friendly reproof to an excess of zeal on the part of some youngster. But Baird was a great man, able, forward-looking and large-minded. He was not only a scientific leader but also an excellent business man and executive; and the respect and confidence inspired by his personality and character were important factors in securing from Congress the funds needed to carry on the long-continued and valuable work of the U. S. Fish Commission. All honor be his!

Whitman was in some respects of very different stamp, far less a man of the world, but no less than Baird a leader of men. His manner was quiet and rather reserved; but, like Baird, he possessed an indefinable personal charm and magnetism that was an important factor in his leadership. He too was a good naturalist and a large part of his time in later life was passed in the study of animal behavior. But Whitman was essentially a product of European laboratories, as Baird was a product of American studies in natural history. He was what we irreverently used to call a "section-cutter"—an excellent technician, a close student of the finest details of development and cell-structure. Together with Charles S. Minot and Edward L. Mark, he was among the first to introduce into this country the refinements of laboratory technique in zoological work. Whatever he undertook was carried out with deliberate and exact care; and there was a certain artistic quality about his work that used to remind me of that remarkable man, Theodor Boveri. This quality set him apart from most of the men of his time and marked a new standard of work for all of us who came into close touch with him. He was a hard fighter, unsparing, almost bitter, in his criticism of what he considered careless or superficial work, but quick to appreciate and encourage merit on the part of younger investigators. In these respects he often made me think of my dear old friend, Anton Dohrn, one of the great leaders of zoology in his time, and the creator of the Naples Zoological Station. If the truth must be told,

Whitman was not exactly what might be called an ideal business man—in fact, his methods (or lack of them) would have filled Baird with holy horror. He used to argue half seriously that a financial deficit was an excellent thing for any laboratory; and in his time the M. B. L., as a matter of fact, always had one. Why waste money, Whitman would say, on fire insurance for the old wooden buildings? Long experience has proved that they are absolutely fireproof—you couldn't set fire to them if you tried—not if you soaked them in turpentine and benzine and put a Bunsen burner under them!

Different as Baird and Whitman were, they possessed certain great and shining virtues in common. Both were men of vision, of imagination, of high ideals and ambitions, steadfast in purpose and forceful in character. Perhaps it may surprise some of you to learn that long before the M. B. L. was born, or thought of, Baird, like Whitman, ardently cherished the ideal of making Woods Hole a great center of cooperative work in biology in which colleges, universities and research institutions should come together in friendly association and rivalry. In Baird's time this was but a romantic dream—one that he did not live to see realized, that perhaps never could have been realized under purely governmental support and administration. Whitman made it a living reality; Lillie, ably seconded by Drew, has brought it to the full fruition, which to-day we celebrate. I would like to think that the disembodied spirits of Baird and Whitman might on this happy occasion be floating around somewhere up there to-day in the blue empyrean and watching our doings here. Could they do so I know they would shake hands (or wings) and go their way rejoicing.

Perhaps in the course of my less serious remarks I may here and there have spoken too lightly of the remarkable modern development of the M. B. L. But if, in contrasting the past with the present era of high civilization and efficiency, I have in some degree fallen into the superior and cantankerous tone that is a common vice among the antiquated survivors of earlier and simpler days, let me assure you that it was in order to end with a serious moral. It is very short. It may be summed up by reminding you that the really important thing in the life of an institution, as in that of an individual, is not the gun but the man behind it. This is, of course, a platitude; but you must permit the oldest inhabitant to remark that great gifts and splendid new opportunities impose great responsibilities and duties. Our generous friends have given to us with overflowing hands, all and more than all, that we have asked for. They have given us more than land, buildings, equipment and endowment. They have given moral support, they have put their faith in us. That faith, I believe, has thus far been justified by our past and our present. We must justify it by our future. We shall fail if in any degree we relax our efforts, if we lie back on our oars and stop to admire the scenery. We must pull harder than ever. And above all things let us hold fast to the spirit of the M. B. L. One of our shining virtues under the leadership of Whitman and of Lillie has been a singular freedom from the vices of self-advertising, over-organization, administrative red tape, machine-made research. For heaven's sake let us strive to keep our future free from these detestable practices. And here's wishing the M. B. L. a steady forward march in achievement and in glory; and may we not forget those who came before us.

Address of Professor Edwin G. Conklin

The address of Professor Edwin G. Conklin, of Princeton University, was entitled "The changing face of nature and of man at Woods Hole," and was illustrated by numerous lantern slides. He briefly recounted the history of the discovery and naming of "Cape Cod," "Martha's Vineyard" and the "Elizabeth Islands" by Gosnold in 1602 and his planting of the first English settlement in America on the site of the present Falmouth in that year. This settlement was soon abandoned and the present town of Falmouth, including Woods Hole, was first permanently settled in 1660. In 1606 Champlain sailed along this coast as far as the present Woods Hole and, mistaking the "Hole" or channel between Buzzards Bay and Vineyard Sound for a river, gave to it his own name. The historian, E. G. Bourne, has suggested that it should now be called "Champlain Strait," but the Yankee preference for plain and homely names still prevails.

There were many stirring events in the vicinity of Woods Hole during the American Revolution and the War of 1812. British war vessels were often in Vineyard Sound and especially at Tarpaulin Cove. On April 1, 1779, a British fleet of ten sails visited Woods Hole, and marines from these ships killed cattle and attempted to burn houses, but were driven off. They returned April 3 and cannonaded Falmouth but were prevented from landing by four companies of militia of about two hundred men. At one time a schooner laden with corn from Connecticut was seized by a British privateer as she was entering the sound and taken to Tarpaulin Cove. Colonel Dimmick, who commanded the militia of the town, was notified of this and with twenty men in three whale boats he pulled to the cove, seized the schooner and

sailed away with her, finally bringing her into the harbor at Woods Hole. In 1812 the British Frigate *Nimrod* bombarded Falmouth and destroyed many buildings and later landed marines at Little Harbor, Woods Hole. Some of these events in the early history of Woods Hole were illustrated by lantern slides from sketches, paintings and old photographs made by Mr. Frank L. Gifford. Some of the most interesting of these pictures were of the whaling industry at Woods Hole, which lasted from about 1815 to 1860. During this period Woods Hole was an important center of this industry and its wharves and buildings were located on what is now property of the Marine Biological Laboratory. The old Stone Building, now occupied by the supply department, was built in 1829 and was known as the "candle factory"; here oil was stored and spermaceti candles made, and evidences of this former use are still seen in the old flues, hearths and cranes in the building. Adjoining the candle factory was a large frame building known as the "bake shop," where all the bread and hardtack was baked for the use of crews of whale ships; this building is now the laboratory's carpenter shop. In front of these buildings was the Bar Neck Wharf, at which whale ships discharged their cargoes; it is now the property of the laboratory and is occupied in part by the Penzance Garage.

Although originally covered by forests the region around Woods Hole was practically treeless in 1850. About that time Mr. Joseph S. Fay began to buy barren, rocky farms in this vicinity and to reforest them, importing and planting many trees on his estate. The "Fay Woods," with their woodroads, which were open to the public, were the joy of early workers at the laboratory, but they are now sadly depleted by the gypsy moth and the inroads of civilization.

The history of Woods Hole as a biological center began in 1871, when Spencer F. Baird, secretary of the Smithsonian Institution, was made the first commissioner of the United States Fish Commission, which had just been established by Act of Congress. Baird opened a laboratory in an old shed on the Lighthouse Board's wharf in Little Harbor in the summer of 1871. During the three following summers he conducted work at Eastport and Portland, Maine, and at Noank, Connecticut, and in 1875 he again came back to Woods Hole, where a laboratory was fitted up on the Government Wharf in Little Harbor, of which Baird said in his "Report" (1876): "With the exception of the building erected by Professor Agassiz at Penikese it is the first formal and permanent sea coast laboratory, constructed and put into operation especially for the purpose, in the United States."

From 1877 to 1880 the work of the Fish Commission was carried on at Salem and Halifax, Gloucester, Provincetown, Newport, and after having tried out these places Baird decided that Woods Hole was the best place for the permanent laboratory of the fish commission. In his "Report" for 1882 he wrote: "After careful consideration of the subject, the choice was found to lie between two stations, Woods Hole and Newport." The former was finally chosen because the sea water there was exceptionally pure, free from sediment or contamination with sewage, while there were strong tide currents and no large rivers to reduce the salinity of the water.

Accordingly the Fish Commission Laboratory was permanently established at Woods Hole in 1881, the land belonging to the present Fisheries Bureau was acquired, and in the following year the present laboratory, wharf and pool were built. In 1886 the "residence" for workers at the laboratory was built, and there Baird died in the summer of that year.

While Woods Hole was thus being selected as the permanent station of the United States Fish Commission another laboratory, short-lived but of great influence, was established by Louis Agassiz on Penikese, one of the Elizabeth Islands, only fifteen miles distant from Woods Hole. This small island about two thirds of a mile long and half as broad, was given to Professor Agassiz by Mr. Anderson for the purpose of establishing there a summer school of natural history, and a large laboratory and dormitory building was erected and the school opened in the summer of 1873. This was, according to Professor Whitman, "the first seaside school of natural history." Louis Agassiz died in December, 1873, and the school was continued in the following summer under the direction of his son, Alexander Agassiz, and was then abandoned, owing chiefly to its inaccessibility.

The influence of the Penikese School was out of all proportion to its length of life; during its brief existence many subsequent leaders in American biology studied or taught there, among these, W. K. Brooks, Cornelia Clapp, Alpheus Hyatt, David Starr Jordan, Charles Sedgwick Minot, Edward S. Morse, C. O. Whitman, Burt G. Wilder and many others. In his address at the opening of the Marine Biological Laboratory in 1888 Professor Whitman said:

> At the close of the second and last session at Penikese in 1874 Alexander Agassiz appealed to the colleges and all interested Boards of Education for support; but all in vain, for not a single favorable reply was received, and so his intention to remove the laboratory to Woods Hole was never carried out. Thus that great and memorable undertaking, after absorbing money enough to build and equip a most magnificent laboratory, was

abandoned for lack of interest on the part of educational institutions rather than of means.

The Marine Biological Laboratory is the immediate outgrowth of a seaside laboratory conducted at Annisquam, Massachusetts, from 1880 to 1886 by the Woman's Education Association of Boston in cooperation with the Boston Society of Natural History. The Annisquam Laboratory was organized to serve the same ends as the Penikese School. Its promoter and director was Alpheus Hyatt, curator of the Boston Society of Natural History, student of Agassiz and inheritor of the Penikese ideal. At first this laboratory was located in half of his own house and later in an old barn remodeled for the purpose. At the end of the sixth session letters were sent out to persons and institutions that might be interested inviting cooperation in establishing a larger and more permanent laboratory. A preliminary meeting was held at the Boston Society of Natural History in March, 1887, when it was decided to raise $15,000 to found a new laboratory. In the course of the next year about $10,000 was raised and on March 20, 1888, the Marine Biological Laboratory was incorporated. The first annual report of the laboratory says that "differences of opinion as to location, policy, etc., were difficult to reconcile," but Woods Hole was finally chosen because Baird had selected it for the Fish Commission Station after ten years of experience up and down the coast from Eastport, Maine, to Crisfield, Maryland. A small plot of land, seventy-eight by one hundred and twenty feet, near the Fisheries Station, was bought for about $1,300 and a two-story, frame building twenty-eight by sixty-three feet was erected on it, which with its water supply cost about $4,000. In the founding of the Marine Biological Laboratory Alpheus Hyatt was the leading spirit, and for two years he served as president of the trustees. Associated with him as founders of the laboratory we must include three other Penikesians, C. S. Minot, W. K. Brooks and C. O. Whitman. Their names, together with that of Agassiz, are now commemorated in the names of the roads on the Gansett property of the laboratory.

The next step was to find a suitable director. Professor Clarke, of Williams College, was offered the post but felt obliged to decline because of ill-health and because he felt there was small chance of success. Professor Whitman, of Clark University, was then offered the directorship and accepted; and it is no disparagement of what others have done to say that the character of this laboratory is due to Whitman more than to any other person. Whitman was in a peculiar sense a product of Penikese. A graduate of Bowdoin College and a teacher of Latin in the English High School, Boston, he got his first inspiration for biological work at Penikese. In his address at the opening of this laboratory July 17, 1888, he said: "The Marine Biological Laboratory traces its historic roots to Penikese. . . . Our minds naturally revert to the old Penikese School." He often referred to Penikese, and its ideals were ever present in his mind and were to a large extent embodied in this laboratory. As our parents live in us, so Penikese lives in the Marine Biological Laboratory.

In his inaugural address at the opening of this laboratory Professor Whitman clearly indicated what these ideals were. "There is great need," he said, "for a laboratory which shall represent (1) the whole of biology, (2) both teaching and research, (3) the widest possible cooperation of educational and scientific institutions. Such a laboratory should not be merely a collecting station, nor a summer school, nor a scientific workshop, nor a congress of biologists, but all these; an institution combining in itself the functions and features of the best biological institutes in the world, having the cooperation of the biologists of this country, and thus forming a national center of research in every department of biology." Again in his first annual report he said:

> The new laboratory at Woods Hole is nothing more and I trust nothing less than a first step toward the establishment of an ideal biological station, organized on a basis broad enough to represent all important features of the several types of laboratories hitherto known in Europe and America. An undertaking of such magnitude can not be a matter of local interest merely and if it be pushed with energy and wisdom, it can not fail to receive the support of the universities, colleges and schools of the country.

There was little in the early conditions of the laboratory to justify such high hopes. It began with no assured cooperation, no constituency, a bare building, no library, no private rooms for investigators, only a rowboat for collecting and with only two instructors, seven investigators and eight students. What it has grown to you see for yourselves. It is probably no exaggeration to say that this laboratory is the very best as it is certainly the largest marine biological laboratory in the world.

The growth of the laboratory in scientific cooperation was rapid, but for more than twenty years its financial support was uncertain and precarious, and its buildings and facilities were inadequate to its needs. In 1890 an L was added to the original building to serve as a lecture room on the first floor and a library on the second at a cost of about $1,000; also the "Gifford Homestead" with about one half acre of land adjoining the laboratory was bought for

$3,500, most of this being given by Mr. Joseph S. Fay; the homestead was used as a "mess hall." In 1892, in order to accommodate the increasing number of investigators, a north wing, equal in size to the original building, was added at a cost of about $4,000. In 1894 a large mess hall was constructed adjoining the homestead, costing about $3,500, and the botanical laboratory was built at a cost of $3,000. In 1896 another building was erected, at a cost of $3,400, to provide a larger lecture hall and additional rooms for investigators.

This rather rapid expansion had taxed severely the financial resources of the trustees, but Whitman insisted on going ahead, even though no funds were in sight. He ordered the building of the new lecture hall in spite of the fact that the trustees refused to authorize it, and he himself afterwards secured the money to pay for it. This continued pressure for expansion on his part led to friction with the trustees and ultimately to the reorganization of 1897, by which the corporation and board of trustees were enlarged and the annual meetings of those bodies transferred from Boston in November to Woods Hole in August.

At that time the total assets of the laboratory were estimated to be about $35,000. Between 1901 and 1905, friends of the laboratory, chief among whom were Mr. Charles R. Crane, Mrs. Frank R. Lillie and Mr. L. L. Nunn, gave for various objects about $25,000, and in 1903 the land on which the Old Stone Building or "candle factory" stands was bought for about $7,000. The following year the laboratory acquired its first water frontage on the harbor at a cost of about $7,000, which was given by Dr. John C. Phillips.

In 1902 the Carnegie Institution of Washington made a grant of $4,000 to the laboratory and during the three following years gave $10,000 each year. This very generous gift and the prospect of a laboratory free from debt and amply supported led the majority of the trustees to favor turning the laboratory over to the Carnegie Institution, but Whitman strenuously opposed this and insisted that the laboratory should remain an independent organization and his opposition led to the withdrawal of that proposal. At that time most of the trustees felt that this was a grave mistake, for the income of the laboratory was several thousand dollars short of meeting current expenses and there was no assured source of funds to meet this deficit or for much needed expansion. But all friends of the laboratory have now come to see the wisdom of Whitman's insistence on preserving its independence.

On January 1, 1907, the total assets of the laboratory were estimated to be about $70,000; they had doubled in ten years. Since that time they have increased almost thirty fold. The initial impulse for this great growth we owe to Mr. Charles R. Crane. Every year since 1909 Mr. Crane has contributed $20,000 to meet the deficits of the laboratory and for other purposes and every year since then he has made some notable addition to our estate. In 1909 he secured for us the Kidder lot, on which this new building stands; in 1911 he gave us the Kidder Annex and lot between the old laboratories and the botany building and also the Woods Hole Yacht Club, now the M. B. L. Club; in 1913 he gave us our first permanent, fireproof building erected at a cost of about $115,000 and dedicated in 1914; in 1915 the old "Gifford Homestead" was torn down and a new and much larger building erected in its place to be used as a dormitory, and in the following year the Ritter house and Whitman cottage were acquired and converted into dormitories; in 1916 the lot on which stands the old "bake house" of whaling days was bought and the building converted into a general shop for carpenters and plumbers, and in this same year a notable step was taken in buying the Gansett property of twenty-one acres, which was subdivided into lots to be sold to workers in the laboratory, and eighteen houses have already been built there; in 1917 the Bar Neck property and wharf, which was the whaling wharf of former days, was bought, as well as the Newman Cottage; in 1920 the mess hall having been destroyed by fire, the present enlarged and improved mess hall was erected in its place; in 1923 the Kidder Cottage was bought and converted into a dormitory, in 1924 the Hubbard house was bought and suffered a similar fate, and this year Dr. Drew's house was bought and is being used as a dormitory. Almost all this great enlargement of the laboratory's estate has been brought about by the generosity of Mr. Crane.

In 1919 efforts were begun to secure a million dollars for a new building and endowment, and in 1922 the Rockefeller Foundation contributed $500,000 and the Carnegie Corporation $100,000 on condition that a million should be raised and that the Friendship Fund, established by Mr. Crane, should endow its annual contribution of $20,000. In December, 1923, Mr. John D. Rockefeller, Jr., contributed $400,000, thus completing the million dollar fund, and the Friendship Fund turned over to a trust company for the benefit of the laboratory $405,000. In addition the Friendship Fund met the cost of this new building and its equipment in excess of $500,000. At present the total assets of the laboratory are more than two million dollars, of which about $900,000 is held as endowment.

Thus has the Marine Biological Laboratory come up from a condition of penury to one of affluence, from a day of small things to one of greatness, from anxious hope to glorious realization. In this story of the growth of the Marine Biological Laboratory there is romance and inspiration, and in dealing with its material growth there has been presented the least romantic and inspiring part of the story. That would be found in the laborious days and wakeful nights and thrilling discoveries of its workers, but there is no time left to tell this part of our history and it does not lend itself so readily to lantern slide illustration.

Let us close with a word of appreciation of the labor and service and sacrifice of those who have made this day possible. Our founders and benefactors have left to us a noble heritage in this institution and its ideals. They labored not for themselves only but for their successors, and we dedicate this building not merely to present but to future generations. Our strongest social instincts are for service; the joy of life is progress; the desire of all men is for immortality through their work. We may be forgotten, as many of our predecessors and benefactors have been, but with Huxley we may say, "I am content to be remembered or not to be remembered so only the truth is advanced." In the dedication of this superb temple of truth, all who have had any part may take a just pride and it is eminently fitting that we should recall with gratitude those who have in any way contributed to this great institution. A common mistake is to fix upon one man, one event, one gene as the cause of some complex development. No one man, foundation or event has been the cause of the Marine Biological Laboratory of to-day. In some measure it is the result of all that has gone before. Nevertheless, there are certain outstanding men who should be recalled with gratitude to-day; among these are the following forerunners and founders: Louis Agassiz, Spencer F. Baird, Alpheus Hyatt, W. G. Farlow, E. G. Gardiner, C. S. Minot, W. T. Sedgwick.

Since its foundation there has been an ever-increasing number of friends and benefactors of the laboratory. It is not possible to name them all, but we should be lacking in gratitude if we failed to name, on this occasion, those who have made possible this great material development of the Marine Biological Laboratory, *viz.*, The Rockefeller Foundation, The Carnegie Corporation, The Friendship Fund, Mr. John D. Rockefeller, Jr., and last but not least, Mr. Charles R. Crane.

Not only to these benefactors but to the men and women who have unselfishly worked here do we owe a debt of gratitude. Others gave their money and influence, these gave their work and their lives. Among them are: C. O. Whitman, director for twenty-one years; Frank R. Lillie, assistant director for ten years and director for eighteen years; H. C. Bumpus, assistant director for five years; J. I. Peck, assistant director for three years, and Gilman A. Drew, assistant director for fifteen years—the man who more than any other one person is responsible for the scientific planning of this building.

Our gratitude is due also to many others—investigators, instructors, students and staff—whose labors have become part of the fame and influence of this laboratory. Among these workers is one whom we sadly miss to-day, but whose name and fame will ever be associated with this place—Jacques Loeb. Many of these founders and workers have gone from us forever, but their memory remains a permanent and priceless possession. "They builded better than they knew." Would that they might be with us to-day to see this consummation of their labors and hopes! "They rest from their labors but their works do follow them." "Others have labored and we have entered into their labors."

This great laboratory, the greatest of its kind, offers an unparalleled opportunity and a serious responsibility. Scientific institutions such as this are the most distinctive and most hopeful contribution of this age to the progress of civilization and of mankind. Gifted with immortal youth, inspired by high ideals of truth and service, may this laboratory be a center of discovery, of learning and of progress to generations yet unborn!

This is a day not only of retrospect but of prospect; not only of rejoicing but of resolution. Here we dedicate not only this building but ourselves to the "increase and diffusion of knowledge among men," to a higher civilization and a better humanity, to the search for truth which shall make us free.

SCIENTIFIC EVENTS

THE WILD LIFE RESERVATION ON THE MISSISSIPPI RIVER

INITIAL steps have been taken by the Department of Agriculture for the purchase of lands for the creation of the upper Mississippi river wild life and fish refuge, authorized by congress in June, 1924.

Funds amounting to $400,000 became available on July 1. The expectation is that ultimately more than $1,500,000 will be expended for the acquisition of overflowed lands on either side of the Mississippi in Illinois, Iowa, Wisconsin and Minnesota for a distance of about 300 miles from Rock Island, Ill., to Wabasha, Minn.

The refuge is designed as a feeding and resting place for wild fowl and other migratory birds and a natural home for fur animals. In addition, it is to be established for preservation of fishes and trees, wild flowers and other native plants.

Secretary Jardine has authority to purchase lands for the refuge, and administration is to be in charge of the Bureau of Biological Survey, which maintains many similar places owned by the government.

Jurisdiction of the Department of Agriculture will extend to wild birds, game, animals, fur-bearing animals, trees, wildflowers and plants where the Department of Commerce will have jurisdiction with respect to fishes, mussels and other aquatic life. The two departments are authorized to make suitable regulations governing hunting and fishing on the areas acquired.

The areas to be purchased are limited to bottom lands between the river and the bluffs, which rise precipitously on each side from 200 to 400 feet. The average price under the law can not exceed $5 an acre. In this region the Mississippi flows through a valley averaging three to five miles in width. At times of high water a large part of this area is overflowed and not suitable for agriculture. There are many permanent sloughs and bayous, some of them navigable to boats of light draft.

To save fish in these cut-off bodies of water the Bureau of Fisheries sends agents each year to return them to the Mississippi or carry them to other localities for restocking depleted streams. Thus millions are rescued every year by federal and state agencies in one of the greatest spawning grounds in the country for such species as bass, pike and sunfish.

NEW PLAN OF STUDY FOR HONORS STUDENTS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

DR. DUGALD C. JACKSON, professor of electrical engineering, has sent to certain students at the Massachusetts Institute of Technology an invitation to become members of the honors group, a plan which was recommended by the corporation's visiting committee on electrical engineering and which the faculty authorized to be put into effect beginning with the next academic year.

The plan provides to the students in the group greater independence of study within the scope and ideals of the curriculum than is characteristic of the usual practice, and includes the following features:

The students in the group will be privileged to attend the class exercises of the regular subjects or not, as they individually please; but will be expected to successfully pass the usual term examinations, which should be readily accomplished as a result of the special reading proposed.

The laboratory work of each term, which now usually consists of a series of independent assignments, will consist of a general assignment relating to the principles of construction and the characteristics of the circuits, instruments and machinery treated during the term, with the time and method of work largely determined by the interest of each individual student, who will carry on under the advice and direction of the conference adviser. Students will be encouraged to carry on this work as far as practicable as individual investigations of the principles and applications under consideration, directed along paths of their own interests in the subject. The usual laboratory reports will be omitted, and the report for each student will be his notebook containing an outline of his plan for the term, the record of his various investigations and measurements, his comments and a brief summing up toward the end of the term of his accomplishments and progress during the term.

Freedom from existing restrictions of scheduled class hours and laboratory hours will afford greater opportunity for more reading and study related to the subjects under consideration. In order that the students' progress may be orderly and any difficulties encountered may be courageously faced and overcome a conference of an hour and a half each week will be held between the group and a member of the faculty learned in the subjects for the term, in which conferences the progress and the difficulties will be mutually discussed. Substitution of subjects in the curriculum will also be provided for to accommodate particular tastes and interests of students.

If the student becomes interested in a particular investigation, even as early as the junior year, that would develop into a suitable thesis project, this may be substituted for the larger part of the usual laboratory work.

For the purpose of stimulating the group to the scholarly thoughtfulness regarding their careers that is needful for distinguished leadership in creative electrical engineering, near the end of the senior year each student in the group will present to his conference advisers an oral statement of his progress and accomplishments during the junior and senior years, with comments on his grasp of the electrical engineering field and its collaterals.

THE NEW YORK INTER-SECTIONAL MEETING OF THE AMERICAN CHEMICAL SOCIETY

AN inter-sectional meeting of the American Chemical Society will be held in New York City from September 29 to October 1. All meetings will be held in Rumford Hall, the Chemists' Club, 52 East 41st Street, New York, at 10 A. M. unless otherwise noted. The following program will be presented:

Symposium on Motor Fuel and Oil Conservation. Dr. C. O. Johns, chairman.

September 29.—"Petroleum aspects of oil conservation": K. G. Mackenzie, consulting chemist, The Texas Company.

September 30.—"Fermentation industries and motor

fuel": Milton C. Whitaker, president of the U. S. Industrial Alcohol Co. "Complete utilization of coal and motor fuel:" A. C. Fieldner, superintendent, Pittsburgh station, U. S. Bureau of Mines.

October 1.—"Motor design and fuel conservation": C. F. Kettering, president of the General Motors Research Corporation.

Fourth Chemical Industry Banquet.

October 1, at 8:00 P. M., banquet to take place at the Hotel Roosevelt. The speakers will be Dr. Chas. H. Herty, president of the Synthetic Chemical Manufacturers' Association, *toastmaster;* Honorable James E. Wadsworth, U. S. Senator from New York, and others to be announced.

Symposium on Artificial Silk.

October 2.—"The development of the artificial silk industry": M. G. Luft, technical director of the Industrial Fiber Company.

Informal Supper and Smoker.

October 2, at 7:00 P. M., informal supper and smoker to be held at the men's faculty club of Columbia University. Dr. Alexander Findlay, of the University of Aberdeen, will speak on "The appeal of science to the community."

THE SCOPES SCHOLARSHIP FUND

Approximately one third of the $5,000 fund being raised by the scientists of the country to further the graduate training of John T. Scopes, defendant in the Dayton evolution trial, has now been collected. Thus far, non-scientists have surpassed scientists, both in numbers interested and in the size of individual contributions; but this was expected, since most scientific men are away from their usual addresses during the summer. With the return of college and university faculties, the response of the profession most interested in the freedom of teaching will become more complete, and the balance of the fund will probably be quickly gathered. A complete list of contributors will be published.

Mr. Scopes has signified his intention to begin his graduate work in geology at the University of Chicago at the opening of the fall term. His thanks, and the thanks of the scholarship committee, are extended to all who by contributions and personal effort have made this recognition of his services to science possible.

Frank Thone,
Treasurer

Science Service,
Washington, D. C.

SCIENTIFIC NOTES AND NEWS

The date of the Oxford meeting of the British Association for the Advancement of Science next year, at which the Prince of Wales will be president, is to be from August 4 to 11. The meeting in 1927 is to be held in Leeds. Vice-presidents appointed for the Oxford meeting include Sir Charles Sherrington, Dr. Gilbert C. Bourne, Professor E. B. Poulton, Sir Arthur Evans and Professor H. H. Turner. New members of the council of the association are: Professor A. L. Bowley, Dr. H. H. Dale, Sir Richard Gregory, Professor T. P. Nunn and Professor A. O. Rankine.

Professor George C. Comstock, of Beloit, Wis., formerly director of the Washburn Observatory of the University of Wisconsin, has been elected president of the American Astronomical Society to succeed Dr. W. W. Campbell, president of the University of California and director of the Lick Observatory. Professor S. A. Mitchell, of the Leander McCormick Observatory of the University of Virginia, was elected vice-president, and Professor Joel Stebbins, of the University of Wisconsin, and Professor Benjamin Boss, of the Dudley Observatory at Albany, N. Y., were reelected secretary and treasurer. Professor H. C. Wilson, of Carleton College, and Dr. W. H. Wright, of the Lick Observatory, were elected members of the council.

The committee appointed by Secretary Hoover to consider questions of policy and reorganization in connection with the transfer of the Bureau of Mines from the Department of the Interior to the Department of Commerce consist of the following: J. V. W. Reynders, president of the American Institute of Mining and Metallurgical Engineers, New York, *Chairman;* C. P. White, chief of the Coal Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, *Secretary;* H. Foster Bain, ex-director of the bureau, New York; J. G. Bradley, ex-president of the National Coal Association, Dundon, West Virginia; L. S. Cates, president of the American Mining Congress, Salt Lake City; D. M. Folsom, vice-president of the American Petroleum Institute, San Francisco; Phil Murray, vice-president of the United Mine Workers of America, Pittsburgh.

Dr. Theobald Smith, director of the department of animal pathology of the Rockefeller Institute, has been nominated president of the International Anti-Tuberculosis Union. At the recent Geneva meeting it was decided that the next international conference should be held at Washington, from September 30 to October 2, 1926.

GENERAL ALLEN, former American representative on the Rhinelands Commission, has received the honorary degree of doctor of medicine, for his services to German public health in connection with relief work, from the University of Frankfort-on-Main.

DR. E. P. FELT, state entomologist, State Museum, Albany, N. Y., completed his thirtieth year of service on September 14.

DR. G. LAGERHEIM, professor of botany in the University of Stockholm, Sweden, having reached the age limit of sixty-five years, retired on September 1, but will continue investigations at the same institution. He is preparing a rust flora of Stockholm and vicinity.

A NUMBER of physicians in Brazil recently sent a greeting engraved on parchment to the retiring professor of neurology at Paris, Dr. Pierre Marie, expressing their appreciation of his scientific work.

PROFESSOR G. CECCARELLI, Perugia, is the recipient this year of the Zannetti prize, given by the Florence Academy of Sciences, for his works on skin grafting.

THE following appointments have been made in the organization of The Koppers Company at Pittsburgh, Pa.: F. W. Sperr, Jr., director of research; O. O. Malleis, chief chemist; H. J. Rose, assistant chief chemist.

DR. ROBIN WILLIS, instructor in the department of geology at Princeton University, has been appointed petroleum geologist for the Texas Company.

THE soil improvement committee of the National Fertilizer Association, Washington, has announced the appointment of Professor John B. Abbott, who for the past five years has had charge of soils extension work in Massachusetts, as consulting agronomist for the northeastern states.

CARL Z. DRAVES, of the University of Washington, Seattle, has accepted a position as research chemist in the Dyestuffs Technical Sales Laboratory of E. I. du Pont de Nemours & Co., Wilmington, Del.

DR. A. A. MICHELSON, professor of physics at the University of Chicago, has returned from Pasadena, where he has been carrying out experiments to determine the velocity of light. He will return to Mount Wilson next May to resume the investigations.

DR. VERNON KELLOGG, of the National Research Council, has returned from Europe where he attended meetings of the International Research Council at Brussels, the League of Nations' Committee on International Intellectual Cooperation at Geneva, and the British Association for the Advancement of Science at Southampton. While in Belgium he was made Commander of the Order of Leopold by King Albert.

DR. J. C. ARTHUR, of Purdue University, and Dr. F. D. Kern, of Pennsylvania State College, have returned from a six-weeks self-imposed mission to Europe. The purpose of the mission, which had the advice and encouragement of the National Research Council, was to consult with the leading uredinologists regarding fundamental propositions and constructive theories pertaining to the development of plant rusts. The question of improved terminology, which might obtain international approval, was also considered. Botanists of Switzerland, Germany, Sweden, Norway, Denmark and England gave frank and critical examination to the matter presented and expressed appreciation of the value of international cooperation.

DURING the summer, Professor R. M. Field, of the department of geology at Princeton University; Dr. C. E. Resser, associate paleontologist in the United States National Museum, and Dr. E. O. Ulrich, also of the National Museum, studied the early Paleozoic rocks of northwestern Europe. They traveled by automobile through Great Britain, Scandinavia, Germany and France. The expedition was a joint undertaking of Princeton University and the Smithsonian Institution.

ROY CHAPMAN ANDREWS, leader of the third Asiatic expedition of the American Museum of Natural History, has reported the safe arrival in inner Mongolia of his collection of dinosaur eggs, fossil skulls and bones, collected on his recent explorations in outlying Mongolian regions. Members of the expedition will sail on the steamer *Taft* for the United States on October 15.

DR. CURT P. RICHTER, of the Henry Phipps Psychiatric Clinic, Baltimore, and Dr. George B. Wislocki, of the department of embryology of the Johns Hopkins University, have returned from Central America, where they studied tropical animal life; most of their time was spent at the Institute for Research in Tropical America.

DR. RADOJE M. TADITCH, director of the bacteriologic laboratory of the State Hospital at Belgrade, is studying at the Johns Hopkins University under the auspices of the Rockefeller Foundation. Dr. Taditch will be assistant professor of hygiene on his return in the Belgrade Medical School.

DR. M. BODANSKY, associate professor of biological chemistry at the University of Texas school of medicine, has been granted leave of absence for 1925–1926 to accept a temporary appointment in the department of chemistry of Stanford University.

SIR ERNEST RUTHERFORD arrived in Adelaide, Australia, on September 3, and on the same day delivered a lecture at the University of Adelaide on "The structure of the atom." Sir Ernest, who is to deliver lec-

tures in the Universities of Australia and New Zealand, returns to England in January.

Dr. Hugh S. Taylor, of Princeton University, will attend the Oxford meeting of the Faraday Society on October 1 and 2, at which a general discussion on "Photochemical reactions in liquids and gases" will be held. Dr. Taylor will read a paper at the meeting.

Dr. Brayton H. Ransom, chief of the zoological division of the Bureau of Animal Industry, died on September 17, aged forty-six years.

Dr. Joseph Warren Miller, instructor of mathematics at the University of Pennsylvania, died by suicide on September 11, aged forty-nine years.

Ellsworth Bethel, curator of the department of natural history in the Colorado State Museum and pathologist for the U. S. Bureau of Plant Industry, died on September 8, aged sixty-two years.

Dr. Henry R. Carter, former assistant surgeon general of the United States Public Health Service and known for his work on the control of yellow fever, died on September 14, aged seventy-three years.

Dr. Louis Starr, at one time instructor in physiology and therapeutics at the University of Pennsylvania, and more recently professor of pediatrics, died in France on September 12.

Sir Francis Darwin, formerly president of the British Association for the Advancement of Science and known for his work on plant physiology, died on September 19, at the age of seventy-seven years.

Professor Otto Lummer, director of the physical Institute of the University of Breslau, whose investigations dealt with interference phenomena and with the estimation of the sun's temperature, has died, aged sixty-five years.

Professor Ernst Erdmann, director of the institute for applied chemistry at the University of Halle, died on August 19, aged sixty-eight years.

Dr. Allen R. McCulloch, of the Sydney Museum, who has been in Honolulu since July 18 to attend the Pan-Pacific Fisheries Conference as a representative of the museum and the government of New South Wales, has died.

J. R. Freeman, consulting engineer, of Providence, has made a gift of securities valued at $25,000 to the Boston Society of Civil Engineers for the establishment of a fund, the income of which is to be used for encouraging research by the younger engineers of the society through the award of prizes for papers on hydraulics and allied subjects.

After a year's effort, approximately $70,000 has been subscribed in the $100,000 mathematics research endowment fund campaign conducted by the council of the American Mathematical Society. It is stated that one fourth of the sum has been subscribed by teachers of mathematics, one fourth by industrial concerns, and the remainder through sustaining and patron memberships. The campaign will be continued intensively during the fall among teachers and industrial concerns.

In addition to the inter-sectional meeting of the American Chemical Society, the program for which is printed elsewhere in this issue, a number of other societies will meet in connection with the chemical exposition which is planned for the week of September 28 to October 3, at the Grand Central Palace, New York. Meetings which have been definitely scheduled, or are expected to be held, include meetings of the American Ceramic Society, Society of Chemical Industry, Technical Association of the Pulp and Paper Industry, the Salesmen's Association of the American Chemical Industry, the National Association of Finishers of Cotton Fabrics, and the American Institute of Chemical Engineers. Others are expected to be added to this group.

The Lowell Institute program of free public lectures in Huntington Hall, Boston, for the season 1925–26, has been announced. The year will begin on October 2, several weeks earlier than usual, and will extend through March. There will be nine courses, embracing such subjects as international affairs, migration of birds and fishes, commerce in the Middle Ages, zoology, literature and statesmanship. Those of scientific interest include a course by Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, on "The migration of birds," and a course of eight lectures by Dr. William T. Bovie, assistant professor of biophysics in Harvard University, subject to be announced later. Dr. Henry B. Bigelow, curator in the Museum of Comparative Zoology, Harvard University, and chairman of the North American Committee on Fisheries Investigation, will give two courses, the first on "The migrations of fishes," and the second on "Recent studies of the North Western Atlantic, physical and biologic."

A complete reproduction of the Davis-Daly mine and its adjacent workings has been presented to the department of geology of the University of Wisconsin by the Anaconda Copper Mining Company, Butte, Mont. The model, which is very large, is valued by the company at about $10,000 and shows the vein structure of the central part of the Butte camp. The

gift was made to Professor C. K. Leith, of the department, who is planning to use it in the class and laboratory study of economic geology. Professor Leith has been doing research in cooperation with the mining company at Butte.

MISS IDA M. MELLEN, assistant to the director of the New York Aquarium, is giving a series of radio talks (Station WEAF) on alternate Fridays, beginning June 5 and extending to December. The subjects are as follows: "The New York Aquarium and its denizens," "Goldfishes and the care of fishes in captivity," "Carps and sea horses," "Fishes that make noises and some that can live out of the water," "Eels and flounders," "Pike, pickerel and muskallunge and how to tell them apart," "Pacific salmon: fishes that bring forth their young alive and those that build nests and defend their young," "Gars and mudfish," "How much does a fish know?" "Sharks," "Poisonous and dangerous fishes and fishes of the deep sea," "Disappearing sturgeon, depleted by over-fishing, and sardines and herrings that no amount of fishing can exterminate," "What do fishes eat?" "What is the fastest fish in the sea?" and "Why is a fish?" A concluding talk will be in answer to the common question, "Is a whale a fish?"

As a result of the interest being shown in the relation of electricity to agriculture, the American Society of Agricultural Engineers at its recent meeting in Madison, Wis., established an electrical division, the chairman of which is yet to be announced. This action was taken because it was felt that the society as a body can undertake some work for which it is especially fitted, such as farm wiring, adapting farm equipment to electric drive and modification of farm machinery. The division will work in close harmony with the state committees already set up in many states by the National Committee on the Relation of Electricity to Agriculture.

UNIVERSITY AND EDUCATIONAL NOTES

DR. A. C. IVY has been appointed professor of physiology and chairman of the Division of Physiology and Pharmacology in Northwestern University Medical School. Dr. Carl Dragstedt has been elected professor of pharmacology. The following promotions have been made in the faculty: Drs. Newell C. Gilbert and William H. Holmes have been made associate professors, and Martin R. Chase, Walter H. Nadler, Lawrence H. Mayers and Leon Unger, assistant professors of medicine. Dr. Loyal E. Davis has been promoted to the rank of associate professor of surgery and has been made director of the department of surgical research and chief of the department of neuro-surgery. Drs. Jacob R. Buchbinder, Sumner L. Koch, Paul B. Magnuson and Victor L. Schrager have been made assistant professors of surgery, and Drs. Carl F. Bookwalter and Ellison L. Ross, assistant professors of otology.

AMONG new appointments announced at the University of Chicago are those of Dr. George M. Curtis and Lester R. Dragstedt to be associate professors of surgery and Junius C. Gregory to be assistant clinical professor (military medicine) in Rush Medical College. Dr. C. Philip Miller, of the Rockefeller Institute for Medical Research, has been appointed assistant professor of medicine and Chester M. Van Allen assistant professor of surgery.

PROFESSOR G. N. ARMSTRONG, of the Ohio Wesleyan University, has been appointed head of the department of mathematics to fill the vacancy caused by the death of Professor C. B. Austin.

DR. EDWARD SAMPSON, of the U. S. Geological Survey, has been appointed assistant professor of geology at Princeton University.

DR. C. I. REED has resigned as a National Research Council fellow and as associate professor of physiology at the University of Kansas Medical School, to accept the position of associate professor of physiology at Baylor University College of Medicine, Dallas, Texas.

DR. HANNAH E. HONEYWELL has been appointed assistant professor of biological chemistry at Pennsylvania State College.

DR. CHARLES TERTZAGHI, head of the department of civil engineering in Robert College, Constantinople, has been appointed lecturer and research assistant in the department of civil engineering at the Massachusetts Institute of Technology.

DR. CHARLES RODEWALD, instructor in the department of chemistry of the University of Nebraska, has been appointed assistant professor in the department of chemistry at Washington University.

DR. CARLOS CHAGAS was recently installed in the newly founded chair of tropical medicine at the University of Rio de Janeiro.

DR. LINA STERN, formerly assistant to the professor of physiological chemistry in the University of Geneva, has been appointed to the chair of physiological chemistry in the University of Moscow.

PROFESSOR B. JANET, of the University of Rennes, has been appointed professor of differential and integral calculus at the University of Caen, as successor to Professor C. Riquier, retired.

DISCUSSION AND CORRESPONDENCE

WHEN DOES WINTER COME?

In connection with the proposed thirteen-month calendar it has been suggested that the first day of the year should be December 22 so as to coincide with the beginning of the winter. A change in the year as a whole will be a very appreciable addition to the other inconveniences necessarily accompanying a change of calendar, and ought to be made in the most satisfactory way if the inconvenience is to be incurred at all. Moreover, at present some extra labor results when meteorological data for the different seasons are referred to dates which do not coincide with the beginnings of months. This trouble is wasted if the choice of dates is not a happy one. It therefore seems interesting to show that the not infrequent practice of beginning the seasons on the 21st or 22d of December, March, June and September (that is, at the solstices and equinoxes), is not only not the best but is actually worse, and a good deal worse, than to begin them with the beginnings of certain months.

The solstices and equinoxes are astronomical phenomena; the seasons are meteorological phenomena, governed by the astronomical events, but not coinciding with them. The winter solstice, for instance, the 21st or 22d of December, is astronomically not the beginning of winter at all, but the middle of winter. To use the middle of one kind of winter as the beginning of another kind has something illogical about it. If it should really be the case that the 21st of December were an appropriate beginning of the meteorological winter, the real, weather winter, a clear-headed person might even regard the coincidence as a cause of confusion and might feel moved to explain that there was a coincidence between two events which readily were of a different character. But if the meteorological winter does not begin on the 21st of December at all, then those who should assign its beginning to the 21st of December would be setting false limits to the winter in order that thereby they might begin it on an illogical and confusing date.

The only practical criterion of the meteorological winter appears to be the temperature. Since temperatures differ in different years and also in different parts of the temperate zone, the determination of the best dates for beginning and ending seasons is necessarily a statistical matter. For this statistical process, however, abundant data are at hand and a result can easily be obtained which, in view of the variations occurring in any one year, would generally be considered quite satisfactory. A curve which has been drawn for the climate of Washington probably coincides nearly enough with the average climate of the temperate zone as far as the beginnings and endings of the seasons are concerned to serve as an illustration here. According to this curve the average coldest day of the year is, within a day or so, the 21st of January; the average coldest 90 days runs from the 7th of December to the 7th of March. Similarly, the middle of summer is very close to the 21st of July, with the whole summer running from the 7th of June to the 7th of September.

It thus appears that by illogically tying up the beginning of one kind of winter with the middle of another, and by splitting months in meteorological calculations dealing with the seasons, we actually may be twice as far away from the real seasons of nature as if we counted those seasons from the first of December, March, June and September.

The practice of beginning the seasons with the solstices and equinoxes seems also to be in conflict with the prevailing usage of the past. The 21st of December, for instance, is called the *winter* solstice, which is an appropriate name if it comes within the winter astronomically and meteorologically, as it really does. But as the beginning of winter it has no right to this name. It thus would be the autumn-winter solstice.

Walter P. White

Geophysical Laboratory

ELEMENTARY TEXT-BOOKS OF PHYSICS

Has the text-book of college physics kept pace with the rapid strides which the science as a whole has taken? To be sure, in the revised editions of the older texts, one finds additional paragraphs dealing with twentieth century developments. Indeed, one recent book devotes the last fifth of its pages to the "new physics." But is not this segregation of the new material a confession that the treatment as a whole is from the old point of view? On my shelf there is a text-book of college physics copyrighted within the last year which has essentially the same table of contents as an edition of Ganot's "Physics" of over fifty years ago. Do not the customary subdivisions, mechanics, sound, light, etc., imply that still the physicist deals with the world of nature directly with his hands and ears and eyes? Is there not need to reorganize the treatment to better emphasize those fundamental relations and principles which, to be sure, appear to the senses in many varied forms, yet really constitute the science of physics from the modern point of view?

Many a college freshman who has been introduced to the subject-matter of physics from the practical point of view in a secondary school course has sufficient experience and background to be taken behind

the scenes and shown the theoretical basis of the stage effects which he has witnessed. Let us consider the nature of a text-book written for this type of student.

Such a text must of necessity be analytical in character, although the formal mathematics used need be no more than that required for college entrance with the addition of the nomenclature of trigonometry. In order to show to the student that mathematics is really the language of the physicist, the book begins with a mathematical introduction. Geometrical optics, developed by the ray method from the principle of rectilinear propagation and the laws of regular reflection and refraction, illustrates the use of geometry and trigonometry. The vector idea is introduced by the statics of a rigid body. Finally, this introduction closes with a brief treatment of kinematics to bring before the student the idea of instantaneous rates of change and of the summation of varying quantities as shown by the slope and subtended area of velocity-time curves. Although no formal calculus is used, it is explained how average or effective values may be dealt with by simple algebraic formulae.

The material in the remainder of the book is grouped in the following parts:

(1) "Energy and steady fields." The concepts of energy, potential and fields of force are introduced with the field of gravity at the earth's surface which is considered as constant. Then the same ideas are applied to constant hydrostatic fields. Finally, universal gravitation, electric and magnetic attraction and electromagnetic radiation are discussed as inverse square fields.

(2) "Dynamics of a rigid body." The concept of inertia is introduced with a dynamical definition of mass. The parallelism between translational and rotational motion is emphasized.

(3) "Flow phenomena." Starting with the customary treatment of hydraulics, the analogy between the flow of water, heat, electricity, lines of electric displacement and magnetic flux is brought out.

(4) "Periodic phenomena." After pointing out the existence of a centripetal acceleration in circular motion with constant speed, the characteristics of simple harmonic motion are developed. It is shown that any system which follows a generalized Hook's law vibrates with this type of motion and often gives rise to a wave motion intimately related to it. Thus a great variety of phenomena from the fields of mechanics, sound, light and electricity is brought together on a theoretical basis and discussed with great economy of effort.

(5) "Kinetic theory." The actual mechanism behind these phenomena, which in the preceding sections are studied from the macroscopic point of view and considered as continuous, is here explained in terms of the motion of discrete electrons and molecules.

The whole development of the text is based on a rigorous set of definitions built up logically from five fundamental concepts—length, l, force, F, time, t, electricity, Q, and temperature. This group of fundamental concepts permits the use of a dimensional analysis which, in addition to checking the student's formulae and aiding him in changing units, gives a more concrete insight into the relations between the various concepts. For example, this analysis permits at once of the electromagnetic conception of light phenomena. Illumination is proportional to the energy which strikes a unit surface per second and thus has dimensions $[\,F\,t^{-1}\,l^{-1}\,]$. This radiant energy depends upon the product of the electric and magnetic field strength in the advancing light wave. The electric field strength, defined as the force per unit charge or as a potential gradient has dimensions $[\,F\,Q^{-1}\,]$. The magnetic field strength defined in terms of the magnetic effect of the current has dimensions $[\,Q\,t^{-1}\,l^{-1}.]$ The product of these two field intensities is at once seen to have the same dimensions as the illumination.

In conclusion, if the aim of a physical science is to systematize our knowledge of the world about us, surely we should not be overwhelmed by the fascination of external phenomena but should look for general fundamental relations and deal with elementary college physics from the theoretical point of view.

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HONEY BEES AND PERFORATED FLOWERS

IN SCIENCE 62, 134, August 7, 1925, Professor Burrill states that honey bees got nectar of *Diervilla florida* through holes made by carpenter bees. The hive bee has been seen making holes in flowers of *Aquilegia vulgaris* (Sprengel 1793, Mueller 1873), *Erica tetralix* and *Nepeta glechoma* (Mueller 1873). It gets nectar from holes made by other insects in flowers of *Trifolium pratense* (Mueller 1873, Belt 1875, Darwin 1877, Pammel 1883), *Aquilegia vulgaris, Corydalis cava, C. solida, Diclytra spectabilis, Lamium album, L. galeobdolon, Melampyrum pratense, Symphytum officinale, Vicia faba, V. sepium* (Mueller 1873) and *Monarda fistulosa* (Robertson 1892).

Having observed 15,172 insect visits to 441 local insect flowers, I have found only four flowers perforated, and then only by *Leionotus foraminatus* and *L. dorsalis*. The following insects used the holes: on *Monarda fistulosa*, besides the hive bee, one *Ceratina*,

seven Halictidae, one *Sphex;* on *M. bradburiana,* none; on *Scutellaria canescens,* three Halictidae; on *Penstemon laevigatus, Leionotus anormis.*

At Orlando, Florida, I saw two Eumenidae and two Vespidae getting nectar of *Gaylussacia hirtella* from holes made by *Odynerus erinnys.*

CHARLES ROBERTSON

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A NOTE ON A ROT OF THE SMYRNA FIG IN CALIFORNIA

AN article published in SCIENCE, August 14, 1925, page 161, by P. D. Caldis, of the University of California, entitled "A rot of the Smyrna fig in California," has been a source of confusion in regard to the name of the fungus causing the rot. The writer has already had several inquiries from pathologists and cataloguers in Washington and elsewhere how to index it.

In the spring of 1924 the fungus was isolated from the fig and the Blastophaga in this laboratory, and as the typical curved septate spores were obtained from both sources it was determined to be a Fusarium. Report of the work was sent to the Fig Growers Association in California in September, 1924. The species was identified by Dr. Sherbakoff in January, 1925, from our cultures and subsequently from one of Mr. Caldis' cultures which had been held under our laboratory conditions for eight months, as *Fusarium moniliforme* Sheldon. It is true that *Fusarium moniliforme* Sheldon has been confused with *Oospora verticilloides* Sacc. when it produces only the microconidial type of spores and on that account it has sometimes been listed as an Oospora. But it is not an Oospora, as might be inferred from Mr. Caldis' article.

The fungus has also been called a Cylindrotrichum, but the presence of curved septate Fusarium spores in infectious cultures determines its proper classification.

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SCIENTIFIC BOOKS

The Downtonian Fauna of Norway. I. *Anaspida, with a Geological Introduction.* By JOHAN KIÆR. Pp. 139, with 50 text figures and 14 plates. Kristiania, 1924, Videnskapsselskapets Skrifter. I. Mat.-Naturv. Klasse. 1924, No. 6.

THIS fine monograph is the first part of an extended memoir on the remarkable upper Silurian fauna discovered by the author and his wife in 1909 at Ringerike, in the southern part of the Oslo area. About 2,500 specimens of crustaceans, merostomes and fishes have been obtained, of which only the anaspidans, including *Pterolepis nitidus* Kiær, *Pharyngolepis oblongus* Kiær, and *Rhyncholepis parvulus* Kiær, are here discussed.

Traquair's views as to the orientation of the body are shown to be incorrect, the dorsal and ventral surfaces being reversed, as had been suspected by some students.

The scale system is shown in all three genera in the most detailed fashion. On the head the hitherto unknown dorsal and gular plate systems, formed by the fusion of smaller scales, is made known and an adequate terminology is proposed. The plates are intimately related with the openings in the head. Of these there are on the dorsal surface, besides the large eyes, a small median opening between the orbits believed to have lodged the pineal organ, and a somewhat larger unpaired opening in advance of this, supposed to be the single nostril.

The large terminal mouth is bounded superiorly by the anterior plates of the dorsal cranial system. Inferiorly it is bounded in one form by a small area of transverse scales, in another by a single moderate-sized median plate, and in the third by well-developed paired plates strengthened by the powerful gular system—apparently indirect stages in the formation of a large, powerful beak. There are no traces of teeth.

As has been known, there are a number (eight to fifteen) of circular branchial openings arranged in an oblique band back of the head. Just posterior to the lower end of this band there is a strong sharp spine in the Norwegian genera which the author considers as a possible homologue of the pectoral fins of the true fishes. There are unpaired anal and caudal fins. The latter is not, as was generally supposed, a normal heterocercal tail, but a reversed heterocercal one, strangely similar to that of an ichthyosaur but unknown among real fishes.

There is no trace of a sensory canal system or of a bony axial skeleton.

Clear, well-drawn reconstructions of the three genera are given.

The remaining fifty-five pages are devoted to the general bearing of these very welcome new facts. As regards the "jawless" nature of these forms, Kiær concludes that there was a definite cartilaginous stiffening around the mouth "which, it is highly probable, may be compared with the mandibular arch in real fishes." The presence of a functional pineal eye and of an unpaired narial opening, believed to be proven, is stressed. The branchial system is held necessarily to have consisted of cyclostome-like pouches, probably without any homologue of the branchial arches of true fishes.

Kiær looks upon the spines of the Anaspida and the lateral lobes of the Cephalaspidae as homologous with paired fins and as originating in lateral fin folds. The absence of any homologue of the pelvic appendages is believed to be primitive.

As regards the affinities of the group the following views are advanced:

(1) He concurs in the "general view" that the Acrania, Cyclostomata and Pisces form three ascending stages in the development of the Chordata (although, to be sure, the Acrania and Cyclostomata as we know them are specialized and to some degree degenerate).

(2) The dermal skeleton was characteristic of a normal stage in this development. The earliest forms were naked, then arose a scale system governed largely by the mechanics of the lateral muscle plates, and passing by later development into various specializations, such as fusion into plates, as in the ostracoderms, or on the other hand reduction or loss.

(3) The unpaired nasal opening and pineal organ, their grouping with the eyes and the structure of the branchial apparatus are believed to be the most important structures of the Anaspida. Now in all these characters they resemble the cyclostomes (Petromyzontia) and furthermore these are just the characters which separate the latter from the true fishes. The unpaired nasal opening is considered especially fundamental and Haeckel's grouping of all vertebrates into Monorhina and Diplorhina is revived. Hence the Anaspida are believed to belong to the same group of monorhine craniates as the cyclostomes. The absence of a dermal skeleton, jaw structures and paired pectoral appendages in the latter are considered secondary due to degeneration.

(4) As to the other groups usually united under the designation Ostracodermata, the Cephalaspidae are close relatives of the Anaspida. Pteraspidae and kindred forms (Heterostraci) are, however, very different, and it is considered probable that they are related to the Elasmobranchii, as Traquair believed. As for the Antiarchi, these forms are so isolated as to be altogether uncertain in position. They can scarcely be assigned any close connection with the Arthrodira and are in any event diplorhine and true fishes.

An outline of the classification which concludes the work may be given here:

Subphylum Vertebrata Craniata.
  Branch I. Monorhina.
    Class I. Anaspida:
      Lasaniidae,
      Birkeniidae,
      Pharyngolepidae,
      Pterolepidae,
      Rhyncholepidae,
      Euphaneropidae.
    Class II. Cephalaspidomorphi.
    Class III. Cyclostomata.

The fourteen plates are reproductions of photographs and bear abundant witness to the wonderful preservation of the material.

The theoretical conclusions of this monograph will undoubtedly give rise to much discussion and some differences of opinion. There is, however, no room for discussion as to the painstaking and accurate nature of the work nor as to its meriting the high praise and wide notice which it will undoubtedly receive. The gaining of a thorough knowledge of these members of the Anaspida, a group so ancient and so fundamental as to be of the highest interest for any student of vertebrates living or extinct, is an event of the very first magnitude.

G. G. SIMPSON

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

REACTION OF OPALINAS TO VARIOUS LABORATORY MEDIA

PHYSIOLOGICAL salt solution has for many years been the traditional and all but universal medium in use for maintaining organisms and tissues in biological laboratories.

In a series of experiments on *Opalina obtrigonoidea*, begun for another purpose, we have however found, rather contrary to our expectations, that physiological salt solution is not as efficient as several other common laboratory media for keeping Opalinas alive. By the use of Locke's solution, 50 per cent. sea-water, etc., Opalinas may be kept alive for a considerable length of time outside of their natural habitat in the cloaca of the leopard frog (Rana pipiens). It has been observed in a number of other instances that sea-water of various concentrations is an excellent medium; this has also proven true in our work on Opalinas. In our experiments it has been observed to be almost on a par with Locke's solution, which we found to be the best of all the solutions we used.

Eight different media were tried with varying results as shown in the table below.

These results we hope will be of interest to teachers of biology who wish to demonstrate or study such parasitic protozoa as are found in frogs. All the protozoa that one may desire may be obtained from frogs used for other class purposes. This may easily be done by removing the cloaca from a freshly killed

LENGTH OF LIFE OF OPALINAS IN VARIOUS LABORATORY MEDIA

	In clear fluid	With cloacal content	With piece of cloaca
Locke's solution	28 hrs.	35 hrs.	73 hrs.
Sea-water, 50 per cent.	22 "	25 "	45 "
Pond water	25 "	34 "	36 "
Ringer's solution	32 "	26 "	35 "
Physiological salt solution	21 "	25 "	25 "
Tap water	13 "	13 "	13 "
Distilled water	9 "	9 "	9 "
Kroniker's solution	4 "	4 "	4 "

frog and opening it in a watch glass half filled with the desired medium. The most satisfactory results are obtained by dividing the material among two or three dishes so that each dish has a piece of the cloaca and a part of the cloacal content. The watch glasses should be kept covered to prevent too great evaporation and consequently too great concentration of the salts. The Opalinas in such a solution may be expected to remain alive and in good condition for two days or more and in the case of *Nyctotherus* for as long as six days.

The above solutions are easily made up and sea-water may be readily obtained at any biological supply station or be made synthetically according to Mayer.[1]

A more complete report on the longevity of *Opalina obtrigonidea* in various media together with other observations is in preparation for publication later.

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ZOOLOGICAL LABORATORY OF THE UNIVERSITY OF KANSAS

[1] "The relation between degree of concentration of the electrolytes of sea-water and rate of nerve-conduction in *Cassiopea*," by A. G. Mayer, from Papers from the Tortugas Laboratory of the Carnegie Inst. of Wash., Vol. VI, 1914. Publication No. 183.

SPECIAL ARTICLES

SURFACE TENSION DETERMINED BY THE RING METHOD

IN recent years a considerable amount of attention has been given to the problem of finding a method by means of which the surface tension of a liquid can be measured rapidly and with some degree of accuracy. An apparatus in which the pull on a ring is measured by means of the torsion of a wire evidently meets the requirements of convenience and rapidity. Such an apparatus has been devised by du Noüy.[1]

According to the simple form of the theory underlying the use of the ring method, the surface tension of the liquid is equal to the pull on the ring at the instant of rupture of the films of liquid divided by twice the circumference of the ring. Unfortunately the values obtained in this way are certainly too high. Paul E. Klopsteg[2] has attempted to explain the high values obtained by the method of the torsion-balance on the ground that as the ring is lifted out of the liquid the zero of torsion no longer corresponds to the zero of the scale. He suggests that as the torsion on the wire is being increased the vessel containing the liquid must be lowered so that the arm will at all times be in its position of zero-balance. This procedure is undoubtedly correct. But I do not think that the simple theory of the experiment even with the procedure advocated by Klopsteg can lead to accurate values of the surface tension.

It is well known that, after the ring has been detached from the liquid, droplets frequently adhere to it. Klopsteg suggests that a correction must be applied by adjusting the zero-balance of the instrument with the droplets adhering to the ring. I hope to show that the magnitude of the pull on the ring is independent of whether droplets are formed on the ring or not.

In this discussion I shall use the following symbols:

R = average radius of ring.
r = radius of circular cross-section of wire used in making ring.
p = total pull on ring in dynes divided by $4\pi R$.
α = surface tension in dynes per centimeter.
s, g = density of liquid and acceleration of gravity respectively.
a^2 = specific cohesion $= \frac{2\alpha}{sg}$
$\alpha = p$ (on the basis of the simple theory).

During the last two or three years, Dr. R. G. Green, of the department of bacteriology, has been carrying out measurements with platinum rings having values of r from .015 to .05 cm and of R from 0.3 to 1.3 cm. We soon found that the value of p is a function of r and R, increasing rapidly with increase in r and diminishing slightly with increase in R. We also observed that a maximum pull is reached before the film breaks. If there is in fact a maximum pull, it is evident that its magnitude will be independent of such phenomena as the actual breaking of the film and the adherence of droplets of liquid to the ring.

At this stage in our studies, I came across an ar-

[1] *Journal of Gen. Physiology*, I, 521–524 (1918–19).
[2] SCIENCE, October 3, 1924.

ticle by M. Cantor[3] in which the present problem is treated in a very complete manner. This article seems to have been overlooked by recent writers on the subject. I shall therefore present some of the results obtained by Cantor and discuss the range of their validity, assuming for the sake of simplicity that the liquid and the ring have zero "contact-angle." At any stage in the process of detaching the ring from the liquid, imagine a vertical plane passing through a diameter of the ring and giving a circle as cross-section of the wire. The inner and outer films may touch this circle at the points A_1 and A_2. If O is the center of this circle, let OA_1 and OA_2 make angles γ_1 and γ_2 with a radius drawn vertically downwards from O. Let k be the height of the lowest part of the wire, and let y_1 and y_2 be the heights of A_1 and A_2 above the general level of the liquid. Let γ and y be the corresponding values as R approaches infinity. Cantor assumes (1) that r is small in comparison with R; (2) that R is sufficiently large to make it possible to write $y = \frac{y_1 + y_2}{2}$ and $\gamma = \frac{\gamma_1 + \gamma_2}{2}$. How large R must be to satisfy these conditions, we shall discuss later. With these assumptions, Cantor obtains the equations;

$$p = \alpha \sin\gamma + krsg \sin\gamma + \frac{r^2 sg}{2}[\sin\gamma\,(2 - \cos\gamma) - \gamma]$$

$$k = \sqrt{\frac{2\alpha}{sg}(1 + \cos\gamma)} - r(1 - \cos\gamma).$$

It is easy to show that p has a maximum value for a certain value of k or γ. Cantor applies his results to a ring made of material of rectangular cross-section. It is, however, not difficult to obtain the corresponding results for a ring made of wire of circular cross-section. Thus we obtain for the state in which p is a maximum,

$$\gamma = \frac{\pi}{2} - \frac{r}{a}\left(1 - \frac{r}{2a}\right)$$

$$k = a - \frac{r}{2} + \frac{3r^2}{8a^2}$$

$$p = \alpha + r\sqrt{2\alpha sg} - \frac{4}{\pi - 1} r^2 sg \qquad \text{(A)}$$

Equation (A) gives the relation between p (which on the simple theory is equal to the surface tension) and α, r, s and g. For practical purposes it is convenient to have α expressed in terms of the other quantities. Algebraic manipulation of equation (A) results in the following:

$$\alpha = p - r\sqrt{2psg} + \left(\frac{\pi + 3}{4}\right) r^2 sg \qquad \text{(B)}$$

[3] Capillaritätsconstanten, Wied. Ann. 47, 399–423 (1892).

For purposes of illustration assume that water at 20° C. is being examined using a ring with $r = .025$. Suppose that $p = 81$. Then the term $r\sqrt{2psg}$ is approximately 10 and the term $\frac{\pi + 3}{4} r^2 sg$ is approximately 1. The important rôle played in these experiments by the magnitude of the radius of the wire is manifest.

It will be remembered that Cantor assumed that R is so large that the average height of the points A_1 and A_2 may be taken as equal to the height of either when $R = \infty$. When $\frac{r}{a}$ is a small fraction, the angle γ does not differ much from $\frac{\pi}{2}$. Let us therefore consider the values of y_1 and y_2 when the ring is replaced by a vertical cylinder. In these circumstances it is well known that to a first approximation,

$$y_1^2 = a^2\left(1 + 0.6095\frac{a}{R}\right) \text{ or } y_1 = a\left(1 + 0.3047\frac{a}{R}\right) \text{ and}$$

$$y_2^2 = a^2\left(1 - 0.6095\frac{a}{R}\right) \text{ or } y^2 = a\left(1 - 0.3047\frac{a}{R}\right).$$

For $R = \infty$, $y = a$. Accordingly we find $y = \frac{y_1 + y_2}{2}$. But this equality holds only when in the expression for y_1 or y_2 we neglect terms in $\frac{a^2}{R^2}$ and higher powers of $\frac{a}{R}$. Now this term in $\frac{a^2}{R^2}$ will have the same sign in both expressions. Accordingly we may infer that Cantor's results are valid when the term in $\frac{a^2}{R^2}$ is small in comparison with unity. By a method of approximation, I have extended the expressions for y_1 or y_2 to include the term in $\frac{a^2}{R^2}$. The results follow:

$$y_1^2 = a^2\left(1 + 0.6095\frac{a}{R} + 0.173\frac{a^2}{R^2}\right)$$

$$y_1 = a\left(1 + 0.3047\frac{a}{R} + 0.040\frac{a^2}{R^2}\right)$$

$$y_2 = a\left(1 - 0.3047\frac{a}{R} + 0.040\frac{a^2}{R^2}\right)$$

These equations, which I submit with some reservation, would indicate that the error committed in using equations (A) or (B) will not amount to more than one per cent. if the term $0.040\frac{a^2}{R^2}$ is not greater than 0.01; in other words if R is greater than 2a. In experiments with water, therefore, R should be greater than 0.75 cm.

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SEX DIFFERENCES IN EMOTIONAL OUTLETS

BEFORE reliable measures of intelligence existed it had been generally assumed that women were less intelligent than men. When these alleged differences in intelligence are measured, however, they have been found on the whole to be practically negligible, if, indeed, there be any consistent sex differences.

Recent test development has made it possible to make similar measures of the alleged differences in the emotional natures of the sexes. We have recently compared about six hundred college men with about four hundred college women on the Colgate mental hygiene tests. These are tests of indirect emotional outlets which are indicative of mental or emotional instability.

There are forty-eight items of behavior pertaining to introversion in the tests. College women we find much more introvert than college men, the average woman appearing to be about 10 per cent. more introvert. This means that women tend—or may be forced—to live their emotions largely within their own mental sphere, while the men live their emotions more in associating with others.

There are thirty-two traits of psychasthenia in the tests. The women are more inclined toward this spurious mental fatigue, being on the average about 20 per cent. more psychasthenic than the men.

Neurasthenia is tested in twenty-two items of the tests. Again we find the women with an excess of these indirect emotional outlets, although not to so marked a degree as they were in psychasthenia.

In signs of hysteria there have been no demonstrable differences. This may be due to the tests lacking validity in the section dealing with conversion outlets. The reliability of this section is about .95, but the validity is low. The reliability of the other sections is above .8, and the validity is high.

The unfavorable showing of women on these tests may be due in part to some selective influence rather than to any inherent differences by and large. Can it be that emotionally unstable women are attracted to college?

In 1910, which is the last year with available figures, one out of every 1,416 men from twenty to twenty-four years of age and one out of every 1,815 women of the same age range were admitted to a state hospital as a mental patient. Among twenty-five thousand college students in 1923–24 the ratio was one man per 1,079 and one woman per 876. Among the general population the incidence of extreme emotional instability as typified in a psychosis is greater among men. Among the college population, however, the incidence is greater among women. This may be due to the age group from the general population being slightly older than the college population. Or it may be due to the woman inclined toward emotional instability entering college.

In practically every instance statistics record an excess of male over female psychoses, both in absolute numbers and in ratio to the general population. Typical figures are those gathered from twelve states in 1919 by the National Committee for Mental Hygiene. These showed one male from each 1,105 of the total male population and one female from each 1,199 of the general population admitted to a state hospital during the year. This shows a slight and perhaps insignificant predominance of psychoses among men.

Some psychoses are the product of physical forces in the environment rather than of indirect emotional outlets. Eight times as many men, for instance, were confined because of traumatic mental disorder. Five times as many men suffered general paralysis, caused by social disease. On the other hand over three times as many women had mental disorder associated with pellagra. These psychoses due to exogenous influences should be eliminated in comparing the inherent emotional differences of the sexes. When these are eliminated the ratio is one out of 1,444 men and one out of 1,355 women. When the psychoses due fairly directly to environmental factors are excluded the balance shifts in favor of the male. This may confirm the findings on the mental hygiene tests and indicate that the college incidence rate of psychoses fairly represents the true conditions with the sexes under somewhat more similar environmental stresses than exist outside of the cloistered seats of education.

Granting, however, that when the present environmental stresses are equalized among students there is a preponderance of undesirable emotional outlets among women we have yet to demonstrate that the difference is inherent in sex. From earliest childhood the restraints and training of the sexes differ and the difference we find in middle adolescence may be a reverberation of this early environment. Our data can not be interpreted as showing that there are innate differences, the differences may be acquired. The trend of opinion is that the emotional outlets such as we are testing are acquired. Data are being gathered which bear on this point. The very practical problem of an effective difference remains, regardless of its origin.

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